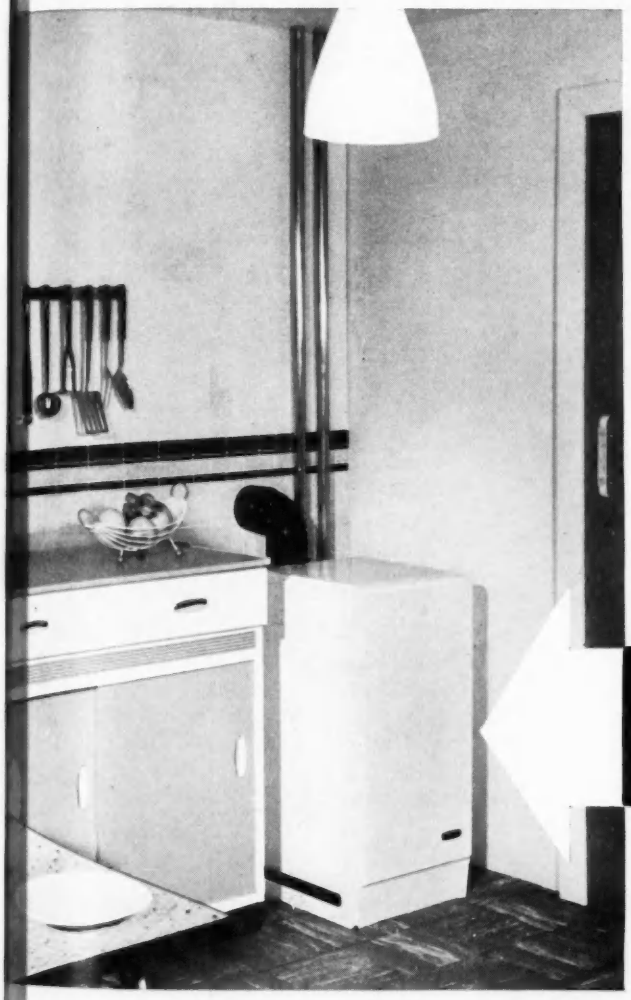
Gas Journal

VOL. 304 112th YEAR LONDON, NOVEMBER 2, 1960 No. 5070 PRICE 1/6

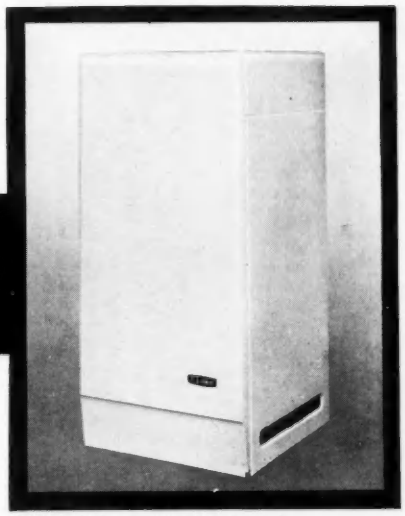
THE ORIENTAL
NOV 21 1960
ENGINEERING LIBRARY

Diplomat Dedicated



The 'Diplomat' Gas-Fired Boiler is dedicated to doing one job, and doing it supremely well—the heating of water for domestic use or central heating (and, as often as not, for both). This the boiler does automatically, efficiently and very reliably. Certainly a 'Diplomat' Boiler is easier to install, simpler to service and requires no daily attention from the householder.

When you sell a 'Diplomat' you are selling not just a boiler but a lifetime of comfort to a satisfied customer.



'Diplomat' is a registered trade mark.

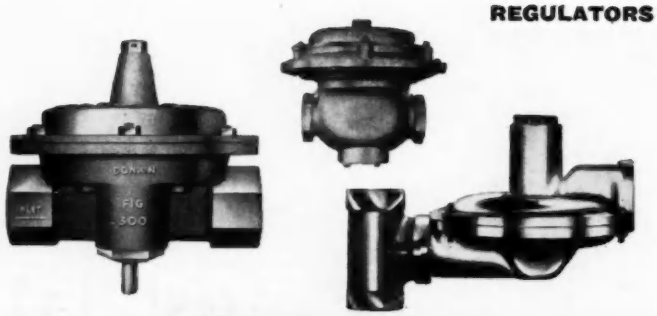
'DIPLOMAT'

Gas-Fired Boilers

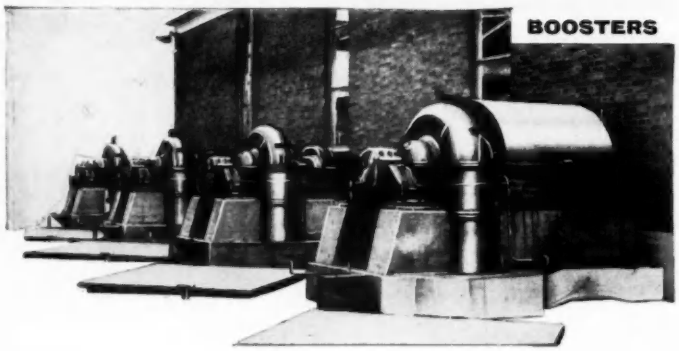
the Key to comfort

THOMAS POTTERTON LIMITED,
20/30, Buckhold Road, London S.W.18.
A member of The De La Rue Group

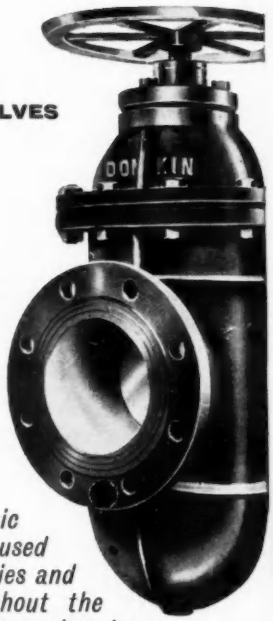
REGULATORS



BOOSTERS

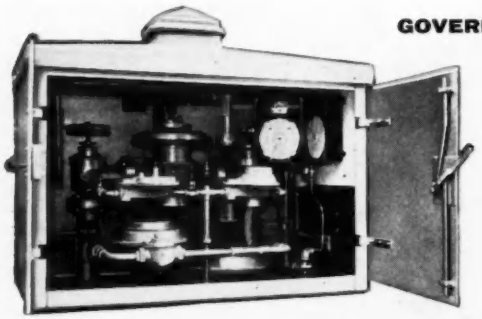


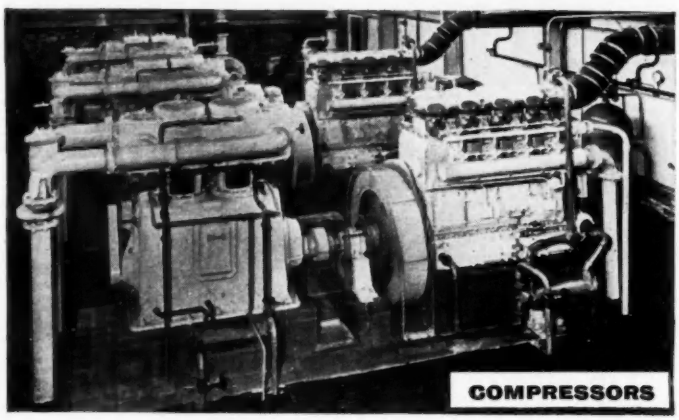
VALVES



Serving Industry

GOVERNORS





COMPRESSORS

Millions of cubic feet of gas are used daily in factories and homes throughout the country. The comprehensive nature of DONKIN equipment is such as to cover every phase of gas distribution and control. Over 150 years experience, sound engineering practice and design together with first class workmanship have proved the reliability of DONKIN products which are well known in many parts of the world.

the

Company Limited

CHESTERFIELD • LONDON • CANADA

for safety's sake...

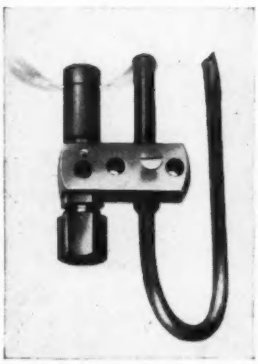
remember

PERL

controls!

a complete range

MAGNETIC GAS VALVES
RELAY VALVES
THERMOSTATS
IGNITION SETS
PROTECTION SYSTEMS FOR IGNITION AND COMBUSTION



in many sizes and types to suit most layouts and applications

PERL CONTROLS LIMITED
672 Fulham Road, London, S.W.6.
REN. 5555 & 5556
also at Crawley and Birmingham

Gas Journal

VOLUME 304 • NUMBER 5070 • 112th YEAR

WEDNESDAY, NOVEMBER 2, 1960

CONTENTS

EDITORIAL COMMENT

Is 200 mill. Tons Too High an Estimate? - - 219
Conventional Carbonisation at Sunderland - - 220

CHEMICAL AND BY-PRODUCTS SURVEY

The Treatment of By-Product Wastes from the Coking and Gas Industries. By R. L. Cooper 221

NEWS SUPPLEMENT

Dispute Grows Over New Gas Heating in Miners' Tavern - - - - - - - - - 227
Personal Notes - - - - - - - - - 227
Obituary - - - - - - - - - 227
Belfast Will Put Up Gas Prices - - - - 227
Scots Sell Old Gas Lamps - - - - - 227
Forthcoming Events - - - - - - 227
New Carbonising Plant at Sunderland - - - 228

GAS IN INDUSTRY SUPPLEMENT

Editorial: Gas for Basic Industries - - - - 289
Metal Finishing—II. By S. Heywood - - - 290
Gas Ovens Solve Hotpoint Problems - - - 294
Gas-fired Tunnels for Tile Making - - - 295
Gas in Basildon New Town. By Eric Ford - - 296
Shipyard Has Gas Radiant Heaters - - - 302
There's Gas Behind that Aluminium - - - 303

Editor:
GEOFFREY W. BATTISON

Assistant Editor:
WALTER F. TRUMAN

Technical Editor:
CHARLES J. P. DE WINTON
T.D., M.A., M.Inst.Gas E., M.Inst.F.

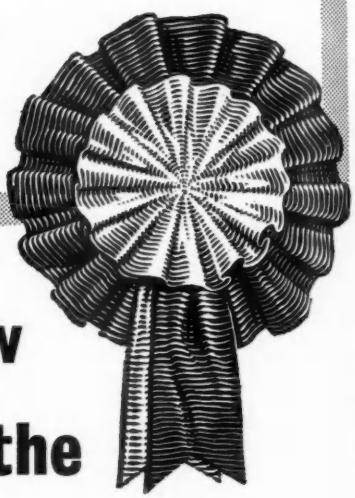
PUBLISHERS' NOTICE, SEE PAGE 124, OCTOBER 19

MAIN leads the way!

first *with the all-enamelled cooker in 1927*

first *with a cooker constructed principally of sheet metal in 1935*

pioneers *of chassisless cooker construction in 1952*



. . . and now first with the SERVERY on the new MAIN MONARCH

★ Keeps plates and food really hot!

★ Simplifies serving up. Room for six large dinner plates!

★ And it cooks too! The servery can be used as a supplementary oven for dishes requiring low-temperature cooking.

R. & A. MAIN LTD. *Gothic Works, Angel Rd., Edmonton, N.18, and Gothic Works, Falkirk.*

C267

Gas Journal

COKE OVENS • BY-PRODUCTS • CHEMICALS

Is 200 mill. tons too high an estimate?

MR. ROBENS' statement that the National Coal Board are going ahead with plans to produce and sell 200 mill. tons of coal a year, poses the question of what are likely to be the demands for energy in this country and Western Europe in the next five or six years. Forecasts of energy, and therefore fuel consumption, in the foreseeable future can seldom be more than inspired guesswork, however well and however thoroughly trends in industrial expansion may be considered; changes invariably seem to occur which render any such estimates valueless.

In this connection, a recent feature article in the *Financial Times* quoting Mr. W. Hodkinson, deputy chairman of the North Western Gas Board, is of considerable interest. In his opinion the increase in total energy demands over the next six years is not likely to be more than 10% and consumption of fuel in the United Kingdom is unlikely to exceed a total of 270 mill. tons coal equivalent by 1965: His grounds for thinking this are that those sectors of the economy which are growing fastest and seem to be continuing to do so, are services and light consumer goods both of which require less energy input than the basic and heavy industries.

Mr. Hodkinson goes on to analyse the share in this total fuel consumption which will be taken by coal and gas on the one hand and oil and electricity on the other. He argues that oil consumption in this country will go on rising at a rate of some 8% per annum, compared with 12% from 1954 to 1959, which would bring the total consumption up to 90 mill. tons coal equivalent by 1965. If 10 mill. tons coal equivalent is allowed for nuclear energy, the balance to be found by coal will only be 170 mill. tons, excluding exports. He points out that gas is losing ground heavily to electricity. The relative rise in prices between 1950 and 1958 is striking. During this period the price of coal rose in comparison to that of oil by nearly 40% and that of gas to electricity by some 23%. This latter rise was the result of tremendous technological developments in electricity generation and the increasing difficulties in the disposal of coke from coal carbonisation.

This is indeed a depressing outlook for the gas industry, but we cannot help feeling that its future prospects cannot be quite so black, though those of the coal industry may well be one of shrinking sales.

Not only has the development of the oil industry had its effect on coal demand, and the discovery of natural gas completely revolutionised fuel usage both domestically and industrially in those countries that are fortunate enough to possess it, but the greater availability of refined fuels generally has had its effect. Increased fuel efficiency, which was preached with almost missionary zeal ten or even five years ago, has had its effect too, not only on the smaller industrial appliance but also on heavy industry, the big users.

The gas industry has, in the last few years, made a steady and determined effort to rid itself of its dependence on the coal industry. Rising coal prices, rising freights and the increasing difficulties met in disposing of coke, have caused the industry to look for other materials for gasmaking that would not only relieve them of the ascendancy of coal, but would be cheaper to use and be free of a residue. Oil and oil products such as refinery gas appear to have provided a suitable alternative, but as yet the proportion of town gas made from such sources continues to be small. The tendency to raise the productivity of existing plants by modifying them to make use of p.f.d. is most noticeable. The enrichment of c.w.g. in this way has made great strides within the last two or three years, and the present tendency to reform an oil product, p.f.d. or perhaps l.p.g. in a vertical retort during carbonisation seems to be gaining ground.

How is it that gas consumption is falling, or is at best stationary? Undoubtedly its use in industry is rising and this rise is about compensating for the fall in the domestic consumption in most of the board areas. It is, however, striking that gas has often made a favourable impression when it has had to compete with an intrinsically cheaper fuel. Ease of temperature control, low maintenance and even heating of the products are the now well-known advantages to be expected from gas-fired furnaces, and with the drive to reduce the organic sulphur content of town gas generally, the last remaining disadvantage should disappear. If the general opinion of gas as a fuel is so high in industry, why should its use by the housewife be falling off?

Available evidence shows that recent efforts to increase the use of gas for space heating are succeeding, and the balancing up the obvious advantages of cleanliness and ease of control against a higher cost of fuel, is coming down in favour of gas. Should natural gas

ever become available in Great Britain at a really competitive price with oil, we feel sure that the gaseous fuel would be chosen in preference by all classes of consumers.

At every turn we notice the flight from coal, and much as we would like to accept a firm figure of 200 mill. tons to be sold yearly from now on, we find it hard to do so. Coal and any form of solid fuel, coke or other processed fuel are, we feel, likely to go through bad times in the years immediately ahead, but by the end of the century the fuel position may well be reversed. Coal, assisted by nuclear energy, may be once more supreme, but that will only be because increased demands for oil and natural gas from dwindling resources may have reversed the price advantages of the latter.

Conventional carbonisation at Sunderland

THE reconstructed gasworks at Sunderland which were opened by the Minister of Power last Friday, is yet another of those examples of conventional plant, each of which is spoken of as being the last of its kind in the board, or the country, depending on how sweeping in his remarks the speaker happens to be. Indeed, it is commonly said that the traditional type of carbonising plant is a thing of the past. But is it? Like the prima donna whose farewell appearances may be confidently expected at regular intervals, new conventional gasworks keep popping up with an insistence which suggests that their usefulness is not as outmoded as the non-traditionalists seem to believe.

Of course, a great deal depends on local conditions, distance from mines, refineries, coke ovens or whatever it may be. In the Sunderland Division of the Northern Gas Board the case for a conventional plant is very strong, and there can be little doubt that the decision is a popular one locally. All the same it would be interesting to know whether the Board would make the same decision if the erection of the plant was under consideration today instead of four years ago.

Conventional the Sunderland plant may be, but it has certain claims to distinction. Its layout is singularly neat and the main architectural features have considerable æsthetic merit; their approval by the Royal Fine Art Commission is readily understandable. As the Minister said at the inauguration ceremony, the plant makes nonsense of the widespread belief that carbonisation cannot be clean and attractive.

After vesting day the Hendon works, as they were then called, became the main gas producing station of the Sunderland Division, which included such districts as Durham, Houghton-le-Spring, Chester-le-Street, Consett and Stanley. During 1956 the Board decided, in view of the age of the existing Hendon gas-making plant, the desirability of closing down less economic works and the annual increase in sales of gas, to reconstruct the Hendon works and to increase its coal carbonising capacity from 3,150,000 to 8 mill. cu.ft. per day (nominal) which becomes, in effect, 9½ mill. cu.ft. per day after dilution with producer gas to 475 B.t.u. per cu.ft. The new plant will provide much better working conditions and amenities for employees, besides eliminating much of the manual labour which was necessary to operate the old plant. Gas manufactured by the new works will augment the gas supply in Sunderland and outlying districts and any surplus will enter the North East coast gas grid for transfer to adjoining divisions.

The works are described fully elsewhere in this issue, but one aspect of the plant seems to us to be worthy of particular comment. This is the use made of television. Five cameras collecting data from various points of the plant are remotely controlled from a control room. In the carbonising instrument room which is situated on the centre line of the installation at top of setting level, the main recording instruments are mounted on a curved panel, all at the same level, so that they may be observed by a camera. Other television cameras are provided in the benzole plant in order to read the station meter, in each boiler room to observe water level and steam pressure gauges, thermometers, and to view the room generally, and in the purifier blower room to read instruments and to view the room generally. With this closed-circuit system the assistant in charge of the control plant can view the plant and take readings of unattended equipment, using an 8½-in. monitor, together with pan and tilt, lens change and focusing remote controls, and a five-way camera switching unit.

We 'looked in' to assess the flexibility, speed and clarity of the system and were considerably impressed. Unfortunately we do not have any information concerning the cost of the equipment and the financial savings which may be effected, if any. Perhaps the greatest advantage is the way in which one can ascertain the exact state of much of the plant within the space of a minute or two, although this is to some extent dependent on the skill of the operator and his familiarity with the job; it seemed to us that a good deal of practice is required before the maximum benefit can be derived from the system. And there is this much to be said: If the operator finds the programmes somewhat repetitive, at least he has the choice of five channels!

At the inauguration the Minister continued the considerable impression he is making at all his gas industry engagements, evincing interest in what he sees and dispensing a good deal of encouragement. 'Now is the time to look forward, not backward,' he told the company at Sunderland. 'There are new markets to be won, new developments in the industry with which to win them.' He warned that intense effort was needed to encourage sales, to increase efficiency and to make gas as attractive as possible, but he added that he had met very few pessimists in the gas industry. 'Most people I have met clearly realise that gas has a fight ahead. You are well equipped to fight. Your equipment is good, your morale is high and your leadership is confident. No troops can ask for more.'

Those are the sort of words we like to hear.

CHEMICALS AND BY-PRODUCTS

The treatment of by-product wastes from the coking and gas industries

By R. L. COOPER,
M.Sc., Ph.D., F.R.I.C., Assoc.M.Inst.Gas E.

IN general the most highly polluting waste common to the coking and gas industries, and the one that has received most attention, is the spent liquor from the ammonia stills. Other highly polluting wastes cannot be neglected however. They include those produced in the coking industry by benzole plant operations and secondary gas cooling, and in the gas industry those effluents arising from the gasification of oil in one form or another and also purifier condensate.

The basic problem in the treatment of such effluents is to arrive at a method which is economic rather than technically successful, and local conditions play an important part in deciding the right method or sequence of methods to employ. Such conditions relate to the geography and location of the works site, available space, arrangement of the various plant units with respect to each other and the nature and size of the local watercourse or availability and capacity of sewers. It has not been found practicable to formulate bye-laws and standards as provided for under Section 5 of the Rivers (Prevention of Pollution) Act, 1951, since experience has shown the problem to be more complex than originally anticipated when legislation was framed. River boards have therefore used the practice of individual consent in the same way as have the local authorities under the Public Health (Drainage of Trade Premises) Act, 1957.

Intensified research

The Water Pollution Research laboratory is being expanded to accommodate the intensified programme of research required to give a better understanding of the many aspects of the effluent problem. Three joint committees have been set up to consider the Water Pollution Research Board's programme and to advise. These joint committees comprise the Board and, respectively, the Federation of British Industries (acting on behalf of the various trade associations), the Institute of Sewage Purification and the River Boards' Association. There is machinery for exchange of information between these three committees and the holding of a yearly joint meeting, has helped considerably to establish good relationships. The Federation of British Industries is paying for basic research on the prevention of pollution by trade effluents, and is concerned with effluent treatment studies and with the effect of pollution on streams, stream life and conditions in estuaries. Research having direct or indirect bearing on the effluent problem is also being conducted by many other organisations including the universities, Government departments, drainage authorities, individual industries and the river boards.

The particular effluent problems of the gas and coking industries continue to be investigated at the University of Leeds under the auspices of the Joint Research Committee of the Gas Council and the University and under the guidance of its Ammonia Effluents Sub-committee. Effluents from many gasworks are discharged to the sewers and consequently a substantial part of the research is concerned with assessing the effect on domestic sewage treatment of additions of gas liquor. Preliminary results from experiments using percolating filters suggest that a higher percentage addition of gas works' spent liquor to domestic sewage than the frequently quoted .5% of dry weather flow of the sewage works might be justified. For coke oven liquors the proportion which can be safely added to purely domestic sewage might well prove to be several times this figure, provided the sewer is big enough.

Best solution

Further work is awaited with interest for, in theory at least, this seems to be the best solution to the problem of such wastes. A number of other methods of waste disposal have been put into practice, particularly where sewers are not available. The ammonia content of crude gasworks liquor (about 2%) favours its disposal to the land as an agricultural fertiliser[1] and some gas boards are making good use of this method. For the average coke oven crude liquor, with an ammonia content of up to about 1%, this is less attractive. Disposal of coking plant wastes to spoil heaps and pit shafts has been practised but cannot be widely recommended, nor can the practice of adding spent coke oven liquor to the water used for coke quenching since this results in severe corrosion of coke cars and the surrounding steel work, necessitating frequent replacement and repainting. A recent investigation[2] has shown the chloride content of the quenching water to be the main cause of corrosion of coke cars.

Value of flow rates

A systematic approach to the problem requires an estimate of the composition and flow rates of the constituent wastes, together with an assessment of the normal degree of variation to be expected. A knowledge of the mass flow rates of individual toxic components (in lb. per day) is of particular value since not only will it put the problem into perspective but also greatly assist in deciding the remedial action to be adopted. For this purpose determinations should be carried out for monohydric and polyhydric phenols, thiocyanate, thiosulphate, free and fixed ammonia, and also cyanide and sulphide if any is suspected. Other constituents, such as chloride, which can affect treatment efficiency should also be determined. Phenols and the thio-salts mentioned, being strongly

CHEMICALS AND BY-PRODUCTS

oxygen-absorbing, are consequently detrimental to stream life and represent a load on sewage purification, while phenols and free ammonia, and particularly cyanide and sulphide, are directly toxic to stream life. Attention should therefore be directed to the removal of these constituents with due regard to their relative toxicities.

It may well be that good plant control or a suitable modification of works practice will help materially. Discharges of tar, oil and gross suspended solid matter should certainly receive attention and be avoided wherever possible, care being taken to guard against leakages or accidental spillages. Reduction of volume of effluent can be effected by proper regard to the efficiency of the ammonia scrubbers, especially with respect to the gas and water temperatures. Replacement of a proportion of the scrubber water by cooled condenser liquor and even cooled spent liquor from the still are well-known methods of reducing the volume, but may or may not improve the treatment position.

Avoid air

In the gas industry it is considered important to avoid addition of air to the gas prior to the inlet of the purifiers to avoid conversion of the volatile sulphide and cyanide, in the condensing and scrubbing stages, to the non-volatile thiosulphate and thiocyanate which otherwise then reappear in the spent liquor. Polyhydric phenols are particularly difficult to treat in any effluent process and if they are partially oxidised this difficulty is increased and highly coloured wastes are produced; moreover, they are disliked by sewage works managers. Separation of tar and liquor where practicable and also separation of retort house circulating liquor from the rest of the liquor as far as possible, *e.g.*, by having separate storage for the former, have been recommended[3] for reducing the polyhydric phenol content of the liquor to the ammonia still.

Hot gas de-tarring

A major modification of works practice which assists in reducing the polyhydric phenol content of crude still liquor is the introduction of hot gas de-tarring. This has been investigated by Dr. W. H. Blackburn and his colleagues at the University of Leeds in conjunction with the West Midlands Gas Board at Leamington gasworks. This work has demonstrated the beneficial effect for liquors discharged to the sewer, even if retort house liquor is not disposed of separately. Obviously further material benefit will accrue if separate disposal arrangements can be made for the retort house liquor, *e.g.*, as a fertiliser, or even if it can be dephenolated prior to the more usual methods of disposal. The investigations of Barker and Hollingworth[4] at the University of Leeds have shown that coke oven liquors generally contain very much lower concentrations of polyhydric phenols, *viz*, of the order of one-tenth of those found in gasworks liquors, and that there is little to be gained from modifying works practice on this account.

One of the major difficulties in the economic treatment of spent liquor is the diverse chemical nature of the toxic components. To this is added the fact that the composition varies markedly from one works to another so that experience with treatment at one plant may not necessarily benefit another. Table 1 indicates the position in the coking industry. Data for a gasworks liquor is also given for comparison.

This diversity in the nature of the constituent chemicals makes it difficult to conceive a one-stage process which will remove all toxic components to a level acceptable to the river boards. Table 2 is an attempt to provide an approximate guide to the economic practicability of applying the various physical and chemical processes which can be brought to bear on the problem. Future research may modify this table in which methods are graded in the following way.

- +++ Recommended and proved.
- ++ Shows considerable promise, some limitations possible.
- \+ Possible.
- – No known economic application.
- x May interfere with or spoil the application of the method for other constituents.

Dephenolation using steam

The following is a brief discussion of each of these methods.

1. Dephenolation using steam is understood to have been successful in the United States. In the Koppers process[5] it is effected in a packed tower through which counter-current low-pressure steam is recirculated, the carbon dioxide and hydrogen sulphide having been removed from the liquor in the free leg of a conventional still. A blower draws the phenol-laden steam from the top of the tower and dis-

TABLE 1. Composition of spent liquors, mg/l.

Constituent	Weak coke oven liquor	Strong coke oven liquor	Average gasworks liquor
Free ammonia as NH_3 ..	100	100	200
Fixed ammonia as NH_3 ..	900	4,000	5,000
Monohydric phenols as C_6H_5OH	700	3,500	4,000
Polyhydric phenols as $C_6H_4(OH)_2$	nil	200	2,000
Thiocyanate as CNS.. ..	300	550	1,500
Thiosulphate as S	250	850	500
Chloride as Cl	2,250	6,500	9,000
4-h Permanganate value as O	1,900	8,500	12,000

TABLE 2. Methods for removing toxic components of liquor.

Method	Monohydric phenols	Polyhydric phenols	Thio-cyanate	Thio-sulphate	Cyanide	Ammonia
1. Distillation, *e.g.* in steam	++	–	–	–	++	++
2. Solvent extraction	+++	++	–	–	–	–
3. Chemical oxidation	++	++	++	++	+	+
4a. Use of active carbon	++	x	–	–	–	–
4b. Adsorption processes	++	+	++	++	–	+
5. Biological oxidation	+++	++	++	++	+	++
6. Use of chemical coagulants	++	++	++	–	+	–

charges it into the lower or caustic section where it is scrubbed with caustic soda to give 95% recovery of the monohydric phenols, the phenol-free steam being re-used. The dephenolised liquor flows by gravity to the fixed leg of the ammonia still. The cost of recirculating the steam is said to be the only cost of consequence. Non-volatile constituents will not, of course, be removed by this treatment.

2. Benzole, butyl acetate and phenosolvan (90% of the butyl ester plus 5% each of the amyl and propyl esters), methyl isobutyl ketone, isopropyl ether and light creosote oil amongst other solvents have been tried on the commercial or pilot scale. Tar bases have been added[6] to improve the partition factor of benzole and light creosote oil. Modern chemical engineering techniques, such as the application of the rotating disc contactor in this country[7] and the centrifugal extractor in the United States,[8] greatly improve removal efficiency. Certain solvents such as benzole remove only the monohydric phenols.

3. The numerous oxidation processes which have been investigated include the use of compressed air, chlorine and chlorine dioxide, nitration,[8] electrolytic oxidation[9] and ozonisation.[7] The two last methods appear to be the most promising, but seem to be confined to final treatment on grounds of cost.

A drawback

4. Active carbon, ion-exchange resins and other adsorptive materials have been examined or employed with some measure of success, but the main drawback is the cost of regeneration and replacement of material either lost mechanically or permanently inactivated. Phenols, thiocyanate and thiosulphate can be concentrated by this process and subsequently recovered from the adsorbent.[10] The use of activated carbon is further mentioned below. The adsorptive properties of coal for phenols can be utilised by replacing conventional tar oils by spent liquor in the froth flotation of coal in washeries. A description of this was given recently by Hall and Nellist;[7] they claimed up to 60% reduction of phenols by this process. The method is, of course, limited to those plants where a coal washery is available.

5. Generally speaking, biological treatment offers the method of widest application from an economic viewpoint. All the constituents listed in Table 2 can be treated in this way, although some are more difficult than others. Thiocyanate is removed only with difficulty in the presence of phenols, and it appears that the latter must be reduced to something of the order of 130 mg/l. before thiocyanate is oxidised. Polyhydric phenols are less easily removed than are the monohydric phenols, and are believed to be at least partly responsible for the residual permanganate value which limits the efficiency of the process. Whether the four-hour permanganate value of a biologically treated effluent is a fair measure of effluent quality in the average set of circumstances remains open to question. Some form of biochemical oxygen demand would appear to be more appropriate, but this is a matter for further investigation.

6. Badger and Jackson[11] have found that the removal of a proportion of the monohydric and polyhydric phenols together with thiocyanate using ferric chloride or chlorinated or aerially oxidised Copperas (hydrated ferrous sulphate) is a promising means of reducing the load on a biological plant. The coagulant may be added prior to treatment or after first stage biological treatment.

In the biological process the toxic effluent components appear to be removed approximately in the order: Monohydric phenols and polyhydric phenols, thiosulphate, thiocyanate, cyanide, ammonia. Abson and Todhunter[12] have suggested a process comprising three separate stages, namely an activated sludge tank for removal of phenols, followed by a percolating filter for removing thiosulphate, thiocyanate and cyanide, followed by an activated sludge tank for removing ammonia. Blackburn[13] favours a single-stage process for removing phenols and the thio-salts where basically two activated sludge tanks are used in series, the first accepting the major part of the load and the second reducing the constituents further and at the same time reconditioning the sludge which is returned to the inlet of the first tank. The process thus becomes more resilient to shock treatment.

CHEMICALS AND BY-PRODUCTS

Promising results

Badger[14] has obtained very promising results using grid packings in towers as an alternative means of applying the biological technique. Evans and Kite[15] have been investigating the limits of the method in conditions of homogeneous continuous culture on the laboratory scale and have obtained extremely high rates of removal for monohydric phenols in the presence of polyhydric phenols, up to ten times that experienced with commercial liquors in full-scale or pilot-scale plant. Table 3 gives the rate of removal of effluent components from spent liquors by biological treatment as found in pilot- or full-scale activated-sludge plant.

TABLE 3. Rates of removal as lb. per 1,000 cu. ft. of aeration tank space per day.

Constituent	Range	Average
Phenols (mostly monohydric) ..	25 to 190	35
Thiocyanate	0 to 20	5
Thiosulphate	30 to 60	40
Ammonia	37 to 66	—

Treatment plant estimates

From the removal rates as determined for each liquor individually on the small scale, the size of the treatment plant required can be estimated providing the mass flow rates of the constituents are known also. A safety factor of up to two may be introduced to allow for variations in composition and other conditions. Badger and Jackman[11] describe a relationship between the rate of removal and degree of purification and consider that above 90% reduction of the permanganate value the biological process becomes uneconomic, thus requiring some form of finishing treatment.

The residual permanganate value, colour and ammonia content of biologically-treated effluents have exercised the minds of investigators for some time. Recent work at the University of Leeds has shown that, while limed liquors are less easily treated than are unlimed liquors, if liming is deferred until after biological treatment the permanganate value of the final effluent is substantially reduced, the colour improved and ammonia formed during the biochemical oxidation of the thiocyanate is removed at the same time as the fixed ammonia originally present in the untreated liquor. Final treatment of this effluent with acti-

vated carbon is likely to be more economical than previous final-treatment methods and can result in a reduction of the permanganate value to 30 mg/l., which should form a useful point of negotiation with river boards. When fouled, the carbon is returned to the makers for re-activation and replacement of lost material. This investigation on the laboratory scale is being continued to obtain an even lower permanganate value and to make the best use of the adsorptive properties of carbon. The distillation with lime of a biologically-treated effluent is the main feature of British Patent 804,544/1958[16] and application has been made for a Patent of Addition for the use of carbon in this connection.

There seems to be little doubt that the biological technique will form the principal stage in the treatment of effluents from the medium- and high-temperature carbonisation of coal, other methods being added prior to or subsequent to this stage. For example, Hall and Nellist[7] recommend prior dephenolation where the phenol content is sufficiently high to allow this part of the treatment to break even, or nearly so, on the sale of recovered phenols. A number of full-scale biological plants have been built at coking plants of the National Coal Board and illustrate the successful scaling-up of a process from investigations on the laboratory scale. One of these plants has already been described in a paper in this series.

REFERENCES

1. A. Marsden, 'Ammoniacal liquor as fertiliser', *Gas World*, 1954, **139**, [illegible]
2. H. M. Lawrence, 'Ammonia liquor as a fertilizer', *Gas Journal*., 1955, **284**, [illegible]
3. T. K. Ross, R. L. Cooper and J. E. Meeks, 'An investigation relating [illegible] the corrosion of coke cars by spent ammoniacal liquor', *Coke & Gas*, 19[illegible] **22**, 143.
4. A. Key, 'Gas works effluents and ammonia' (2nd edn., revised by P. [illegible] Gardiner), I.G.E; London, 1956, p.79.
5. L. Barker and N. W. Hollingworth, 'An investigation into the composit[illegible] of ammoniacal liquor. II—A survey of effluents produced in the gas and coking industries', Gas Council Research Comm. GC52, 1958.
6. H. A. Gollmar, 'Coke and gas industry', Ind. Eng. Chem., 1947, **39**, 5[illegible] H. H. Black, et. al., 'Industrial wastes guide : by-product coke industry', *Sewage and Industrial Wastes*, 1957, **29**, 53.
7. D. G. Murdoch and M. Cuckney, 'The removal of phenols from gasworks ammoniacal liquor', *Chem. Age, Lond.*, 1946, **55**, 493.
8. D. A. Hall and G. R. Nellist, 'Treatment of phenolic effluents', *J. Appl. Chem.*, 1959, **9**, 565.
9. W. J. Podbielniak and H. R. Kaiser, 'Dephenolizing with centrifugal extractors', *Blast Furn.*, 1956, **44**, 760.
10. N. M. Potter and J. W. Hunt, 'The biological treatment of coke-oven effluents', 'Air and water pollution in the iron and steel industry', Iron St. Inst.: London, 1958, p.207.
11. E. I. Akeroyd and G. W. J. Bradley, 'Effluent purification at the Avenue carbonization and chemical plant of the National Coal Board', 'Air and water pollution in the iron and steel industry', Iron St. Inst.: London, 1958, p.203.
12. E. H. M. Badger and M. I. Jackman, 'Loadings and efficiencies in the biological oxidation of spent gas liquor', *Coke & Gas*, 1958, **20**, 316.
13. J. W. Abson and K. H. Todhunter, 'Factors affecting the biological treatment of carbonization effluents', *Gas World—Coking*, 1959, **54**, 61.
14. W. H. Blackburn, private communication, 1960.
15. E. H. M. Badger, contribution to discussion, 'Air and water pollution in the iron and steel industry', Iron St. Inst.: London, 1958, p.228.
16. C. G. T. Evans and S. Kite, 'The application of homogeneous continuous culture to the treatment of spent liquor', paper to Symposium on Continuous Culture of Micro-organisms, Soc. Chem. Ind., Microbiology Group, London, March-April 1960.
17. Gas Council, 'Improvements in and relating to the treatment of effluents from coal carbonising plants,' B.P.804, 544/1958.

American Gas Journal—Gas Handbook issue

THE 1960 edition of the Gas Handbook issue of the American Gas Journal has recently been published, and contains a great variety of information of interest to the gas engineer. Since this Journal is essentially for the gas transport and distribution industries, there is nothing in it of immediate concern to the production engineer, but to the distribution engineer for whom it is primarily intended, it is packed with interesting facts.

The first section deals with gas distribution line flow calculations and includes formulæ, graphical illustrations and a table of 'AA' factors, together with a series of examples and queries to be worked out, which explain the application of the formulæ provided. A similar pattern is followed for low pressure gas flow calculations, and nomograms provide an easy means of calculating pipe storage capacities, and of solving complex pipeline formulæ A leakage conversion chart is also included.

Extracts from A.S.A. Code B31.8—1958 explain the gas distribution piping systems' standards, and include a diagram showing an actual pipeline layout from the gas well to the high and low pressure distribution systems. Other sections deal with the testing of mains after construction, the safety of welders undertaking work on distribution systems, and back filling and soil stabilisation.

The 'Cost-imating' section shows a series of tables in which a materials and equipment cost index is given from 1954 to 1960 as a percentage increase over 1947-49 taken as 100. Gas distribution construction—installed cost index—can also be found from a series of tables divided into six regions with individual cost items given as at January 1, 1954-60, as a percentage rise from January 1, 1949.

The remainder of the issue is concerned with purely technical points dealing with gas distribution. Corrosion is referred to and data concerning the electromotive characteristics of metals is discussed. Corrosion control and protective coating for both mains and services are dealt with concisely; drawings of typical service connections and the most effective methods of wrapping them clearly illustrate the points made.

Gas service design is of some importance and the provision of charts and tables as a guide to pipe sizes, the capacity of copper tubing, etc., is extremely helpful. Line drawings showing different ways of making the service connection to the main are instructive.

The design and ventilation of governor houses or 'regulator stations' is considered in some detail, as is the calculation of 'regulator' capacities. The solution of 'regulator' freeze problems is also referred to.

After a section dealing with gas meters, their capacities, types and accuracy, the question of odorising natural gas in all its aspects is considered. This particular subject is becoming of increasing interest to the British gas industry as limited quantities of natural gas, Lurgi gas and large volumes of oil gas take the place of conventional coal gas in town gas supplies.

The American gas industry appears to be taking more interest in the production of peak load gas from l.p.g. and a section on the handling and storage of these gases at 'utility' gas plants includes a detailed list of the standards of equipment, quality of workmanship in the fabrication of tanks, pipework, etc., and their installation; even the importance of container markings is referred to. This is another aspect of the American gas industry in which the British industry is taking a good deal of notice since more and more area boards are installing this equipment.

Such a publication as this, packed with the kind of exact information needed by the gas engineer concerned with the design, maintenance and the actual carrying out of a project connected with gas transport or local distribution, is most valuable but its form as an enlarged ordinary issue of the American Gas Journal might seem to British gas engineers a little impermanent and ephemeral. An issue in the form of a small book which could be slipped into the engineers briefcase would seem to meet the case more adequately. Perhaps the American industry feels that practice and processes are changing so rapidly that issued in its present form, this publication suits its users best; however, fundamentals do not change, though their applications may.

Dispute grows over new gas heating in miners' tavern

TROUBLE has flared up in the little Midlothian mining town of Newtongrange over the installation of gas heating plant in a £20,000 extension of the Dean Tavern. Despite opposition from the local mining community, officials of the National Coal Board and the National Union of Mineworkers, there is to be no hold-up in the work of converting the heating at the Dean Tavern from coal to gas. The Tavern is run by a committee, most of whom are miners from the local collieries, on a non-profit-making basis.

The two sides of the coal *versus* gas question were thrashed out at a meeting in the Tavern between the committee and a miners' deputation. Giving support to the Tavern's case was Mr. Thomas Smith, an official of the Scottish Gas Board in Edinburgh. With the miners were Mr. R. L. Foxwell, the National Coal Board's Chief Fuel Technologist, and Mr. L. Fergus, of the Marketing Department of the Board.

After the meeting Mr. A. Aikman, Chairman of the Dean Tavern Committee, said that there was no turning back in their plans. Some of the work had already been done.

Mr. N. S. Currie, secretary of the Dean Tavern, said that already commitments had been entered into amounting to considerable sums of money. If there were any changes, they would involve the Tavern in a very considerable loss.

It had to be pointed out that modern conditions were demanded in the 'trade' not only by Act of Parliament but also by the public. It had been decided that gas was the most suitable fuel in all the circumstances.

Mr. T. Kerr, a member of the Executive of the Scottish Area of the National Union of Mineworkers, said they had put forward the case that the building should be heated with coal because it was in a mining community. Of the Tavern's customers, 98% were miners, and if the mining community decided to stage a boycott of the premises it would probably have to close down.

NEWS SUPPLEMENT

Belfast will put up gas prices

INCREASES recommended by the Belfast Corporation Gas Committee will mean that domestic consumers will pay about threepence a week more.

The Committee decided to reduce the discount of 10% for prompt payment of accounts to 5%. There will also be some minor adjustment in the block tariff, to encourage consumers to use more gas by offering a greater reduction in price after the average quantity has been used.

The increases in wages and coal price will cost the department from September, 1960, £45,000, and £79,000 respectively, a total of £124,000. With additional revenue from coke at £25,900, the total net-increase is £98,100.

PERSONAL NOTES

MR. R. C. WARDELL, Group Manager of the East Midlands Gas Board at Boston, Lincs., has been appointed Works Engineer of the Board at Scunthorpe.

MR. P. E. DAW, formerly of Bratt Colbran Ltd., has been appointed Designer and Publicity Manager of William Sugg & Co. Ltd.

MR. D. A. FOSTER is Chairman for the forthcoming year of the East Midlands Salesmen's Circle, Leicester and Northants' Section.

MR. CLIFFORD E. PASSMORE, aged 31, has been appointed Field Sales Manager for the Midland Region of Griffin & George (Sales) Ltd.

OBITUARY

MR. HARRY W. CLARKE, who spent a lifetime in the gas industry, has died. Shortly after the first world war he joined Alexander Wright & Co., Ltd., having been a chemist at the Southampton gasworks, and was eventually appointed joint managing director.

MR. JAMES HUBERT MORLEY, until recently deputy chairman of Morley Products (Padiham) Ltd., has died, aged 67. Mr. Morley and his late brother founded the firm of Morley Products in 1938.

Scots sell old gas lamps

IN six months the Edinburgh Corporation has sold nearly 1,000 old gas lamps which have lighted areas of the city for half a century. Although about half were bought by a London scrap firm, many of the others have been purchased by former citizens for their sentimental value.

One of the largest orders came from the United States Overseas Airlines Company. The Airline purchased 70 lamps and 20 columns, with a request for more when they become available. They sent one of their airliners from Paris to Turnhouse airport to transport their purchases to one of the islands of Samoa. There they will be used to light the streets of a village which is being built to commemorate associations with Edinburgh-born Robert Louis Stevenson.

Lamps sent overseas which are over 80 years old are free from Customs duty, but a man in New Zealand who acquired two later lamps paid £25 duty.

FORTHCOMING EVENTS

November 8. — THE INSTITUTION OF CIVIL ENGINEERS: Great George Street, Westminster, S.W.1. 'Some Contributions from Nuclear Power to Engineering Practice,' by Ian Davidson. 5.30 p.m.

November 11.—LONDON AND SOUTHERN JUNIORS: 'The Development and Growth of Factory Estates,' by H. Capper.

November 12.—MANCHESTER DISTRICT: JUNIORS: Visit to Courtaulds Ltd., Trafford Park. Talk by representative and exhibition of products.

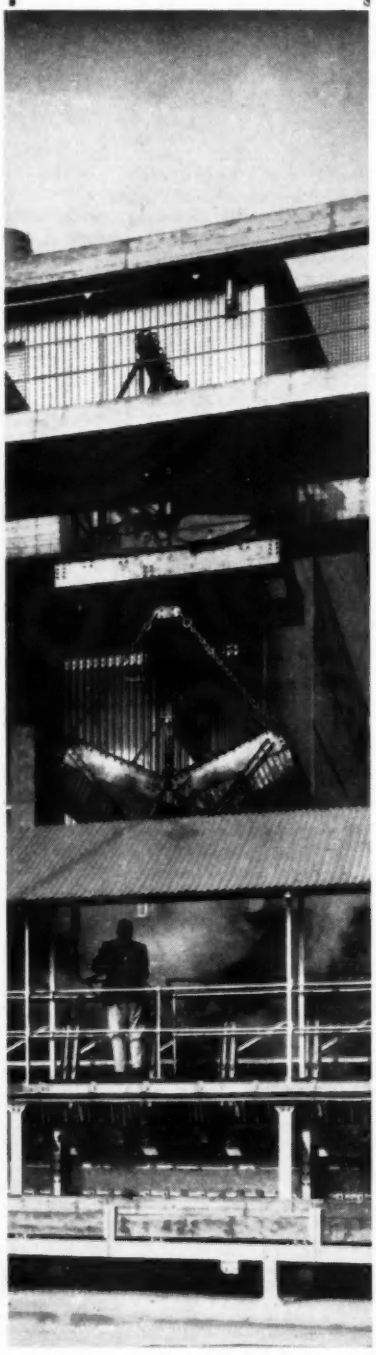
November 12. — WESTERN JUNIORS: Swindon. Paper on 'Industrial Uses of Gas in British Railways,' by A. Riley.

November 15.—I.G.E., LONDON AND SOUTHERN SECTION: 'Oil Refinery Operations and Refinery Gas Production, by G. R. Storey.

New Oxford showroom

Leases are to be granted for 11 more shops at the new Cowley Shopping Centre being erected by the Oxford City Council. Among them is one for the Southern Gas Board.

DISCHARGE OF COKE



The coke wharf, showing the discharge of quenched coke.

● THE £2 MILL. GASWORKS at Sunderland, inaugurated last week by the Minister of Power, the Hon. Richard Wood, is essentially an orthodox carbonising plant but completely up to date in its conception. The very fact that the old name, the Hendon works, has been dropped in favour of the Sunderland works emphasises the break with the past.

● GAS-MAKING CAPACITY of the new plant is more than double that which it replaces and if the total output from the works including dilution by producer gas is considered, it has risen more than threefold.

● MODERN INSTRUMENTATION, coupled with closed circuit television, makes possible a far greater degree of centralised control of gasworks processes.

SUNDERLAND

DEMOLITION of the old Hendon Works plant at Sunderland proved a far more formidable task than had been anticipated. The hard, solid, massive brickwork of the old No. 2 retort house, built in 1894, was indeed a tribute to the materials and workmanship put into the original plant, but it caused a delay in starting the new construction of 11 weeks, so work did not begin until April 1958. This was followed by the demolition of No. 1 retort house in March 1959.

GOOD CLAY

Previous constructional work at the Hendon Works had shown that good clay existed over part of the site, but in order to confirm the strata in the actual area of the new works, eight boreholes were sunk, each to a depth of 30 ft. which indicated that good boulder clay was to be found over the whole site within a few feet of the surface. Unconfined compression tests carried out on samples of undisturbed clay, taken from each borehole confirmed that all footings could be spread, that no piling was necessary and that a load of 2 tons per sq.ft. could safely be superimposed by foundations on the clay.

SUBSIDENCE

Investigations were also made into the likelihood of subsidence due to coal mining under the site. A 330-ft. wide barrier of coal, running diagonally across the site has been left, so that little subsidence due to mining should take place even though partial extraction of coal may be practised at some time in the future.

The carbonising plant consists of two independent units arranged side by side, each of which is divided into two benches, and each bench comprises 18 C.O.L.

HISTORY

SUNDERLAND gasworks, formerly Hendon works, was originally constructed in 1860. It occupies an area of 23.4 acres, of which 2.9 acres have been developed as a sports field.

The works is sited within a few hundred yards of the North Sea, and is only separated from it by a branch line and sidings of British Railways.

By 1902 the sale of gas in Sunderland was increasing rapidly, and continued to do so despite severe competition from other forms of fuel during the 20 years after the 1914-18 war. This was mainly due to the management being able to produce very cheap gas. This was especially important since the relatively cheap fuel manufactured helped new industries to the Sunderland area during the depression of the 30's.

After nationalisation the Hendon gasworks became the main gas producing station of the Sunderland Division and, in 1956, the Northern Gas Board decided to reconstruct it and to increase its gasmaking capacity from 3.150 mill. to 8.0 mill. cu.ft. per day (nominal) which becomes, in effect, 9.5 mill. cu.ft. per day after dilution with producer gas to 475 B.t.u. per cu.ft.

Gas manufactured at the works will augment the supply to consumers in Sunderland and outlying districts and any surplus will enter the North East Coast gas grid for transfer to adjoining divisions.

NEW WORKS BOOSTS TOTAL OUTPUT BY MORE THAN THREEFOLD

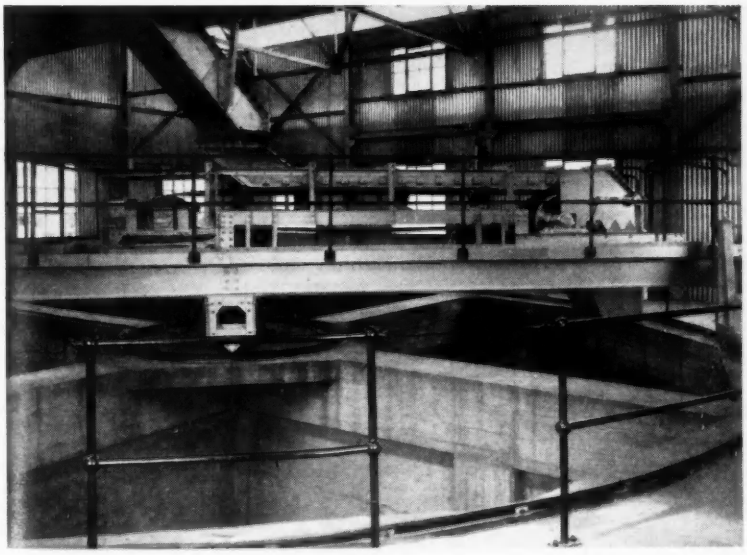
intermittent vertical chambers arranged in three settings of six chambers each. These 72 chambers, after making due allowance for scurfing, are capable of carbonising 540 tons of coal per 24 hours and producing a total of 8 mill. cu.ft.

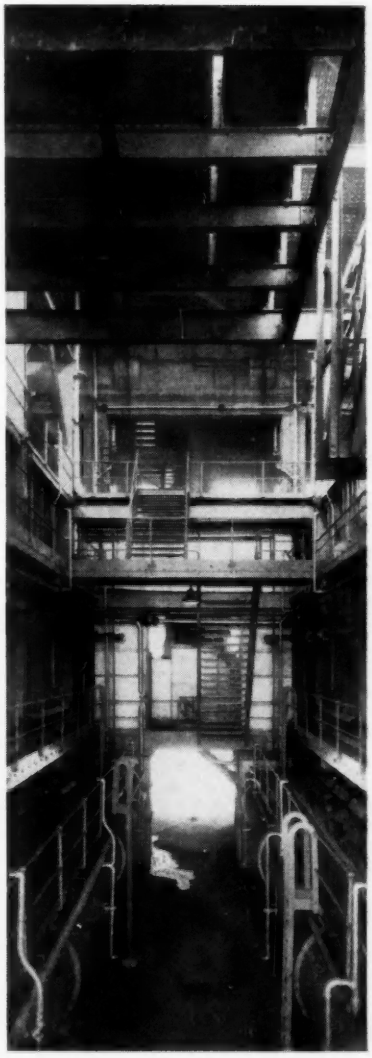
CAPACITY

gas. With a height of 23 ft. 7½ ins., each chamber has a capacity of 4·14 tons when carbonising a coal with a density of 52·5 lb. per cu.ft. Each setting of chambers is built as an independent unit which is free to expand vertically, and allowance has also been made for the accommodation of horizontal expansion. The differential expansion between the firebrick lower courses and the silica of the chambers has also been allowed for. The heating of each individual chamber is by five C.O.L. burners superimposed one above the other. Burner blocks are provided with independent control of the gas and air, while further regulation is by valves to each flue, adjustable from the producer gas valve platform at the recuperator side of the settings. The recuperators for pre-heating the air for combustion are built monolithically with the settings from standard tongued and grooved bricks.

Each chamber is provided with three heat-resisting cast-iron charging-hole frames, and the lids have spherical seatings, together with a smaller oiling-hole frame and lid. The supply of secondary air to the settings, admitted through cast-iron boxes is regulated by slides and graduated scales. The bottom doors and frames are manufactured from a special heat-resisting metal and each door is provided with a machined knife edge which makes a gas-tight metal-to-metal joint with a machined facing on the underside of its corresponding frame. To protect the upper sides of the doors, each is fitted with a series of heat-resisting cast-iron domes which, in addition to reducing the amount of pad coke required, protect the door

The rotating conveyor over the coal mixing bunkers.

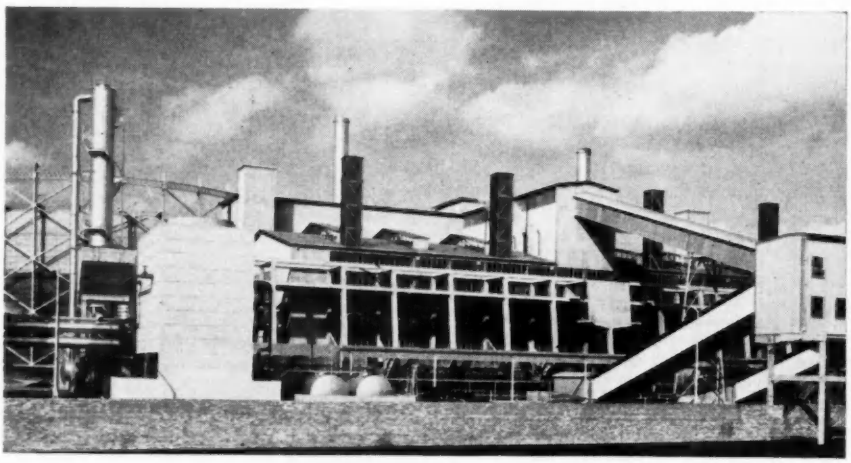




A view of the carbonising plant from between the benches.

New C.O.L Intermittents at SUNDERLAND

8,000,000 cu. ft. per day



The illustration shows the new plant and ancillaries from the seaward side.

Thermal output and flexibility were among the factors influencing the decision to instal a new C.O.L. intermittent vertical plant at the important Hendon Works of the Sunderland Division of the Northern Gas Board.

The new plant, now inaugurated, consists of 72 fully recuperative chambers heated by mechanical producers and complete with coal handling and coke grading plant. Nominal capacity 8,000,000 cu. ft. per day.

WEST'S

GAS IMPROVEMENT CO. LTD. (C.O.L. Division)
Chandos House, Buckingham Gate, Westminster, London, S.W.I.
TELEPHONE: ABBey 6912
HEAD OFFICE: ALBION IRONWORKS, MILES PLATTING, MANCHESTER 10
TELEPHONE: COLlyhurst 2961

S3

from exposure to excessive heating. The domes are hollow, and form passages for the gas to pass through on its way to the bottom offtakes, which relieves the bottom of the chamber from excessive gas pressure. Each door is opened by gravity and closed hydraulically, but a hand-operated winch of the worm-reduction type, supplied for each bench, can be operated quite easily by one man in cases of emergency or complete hydraulic failure.

COLLECTING MAIN

Gas passes through a mild steel, refractory-lined offtake pipe into a common collecting main extending the full length of the bench. From the collecting main the tar and liquor pass to the decanting tank and the gas rises through two risers into the foul mains to the primary condensers, and thence to the exhausters housed at ground level in the main bunker structure. Askania governors installed in each foul main, are accessible from the charging-floor level.

Hot decanted liquor is recirculated from the decanting tank by liquor pumps to sprays at each top offtake and at points adjacent to the governors. A foul gas blow-off pipe is provided for each bench and is fitted with a remotely-operated shut-off valve. Gas evolved at the bottom of each chamber passes through a bottom offtake into a common collecting main, which also serves as a tar main; a rising connection fitted with a shut-off valve and a liquor spray, from this main conveys the gas into the top collecting main. Each bottom offtake is fitted with a cleaning cover, screw-down locking gear and an isolating valve. Temperature and pressure indicators and recorders are provided on each bench for gas and liquor.

The chamber house which also houses the gas producer plant, is independent of the benches, and its framing consists of self supporting welded steel bents. It is roofed and side clad in aluminium sheeting; the roof sheets are specially perforated to provide ventilation and there are four large areas of 'curtain wall' glazing. Two electrically-operated lifts at the north-west and south-west corners respectively of the house, give access to all working levels up to and including the shuttle conveyor floor over the top of the coal and pad coke bunkers. The extensive vacuum cleaning system consists of two fixed plants sited at ground level, each with a separate pipework installation.

The separate bunkers for the coal and pad coke provided for each bench, are of reinforced concrete construction and are arranged at the opposite end of the carbonising house to the quenching chambers. Each with a capacity of 270 tons of coal and 40 tons of pad coke, the bunkers are built in pairs—one pair for each unit—and the space between them is filled in at each side with reinforced concrete panels down to the underside of the hoppers. This section of the building is covered by a flat reinforced concrete roof provided with Perspex domed roof lights.

OUTLETS

The coal sections of each bunker are provided with nine outlets and the pad coke section with three outlets, each outlet being fitted with a quadrant gate arranged so that three units work together.

In an instrument room placed on the centre line of the installation at top of setting level are housed the main recording instruments, mounted on a curved panel and all fixed at the same level.

This arrangement permits observation of the instruments by one of five television cameras collecting data from various points of the plant, all of which are remotely controlled from a control room at ground level where the receiver is located.

Part of the space below bench top floor level houses the boiler installation, the remainder being sub-divided to form offices, messrooms, changing rooms, etc. At ground level the area is sub-divided to house the turbo-alternator, exhausters, laboratory, producer air blowers, boiler feed pumps, Fairweather recording calorimeter, and to provide a first aid room and a control room.

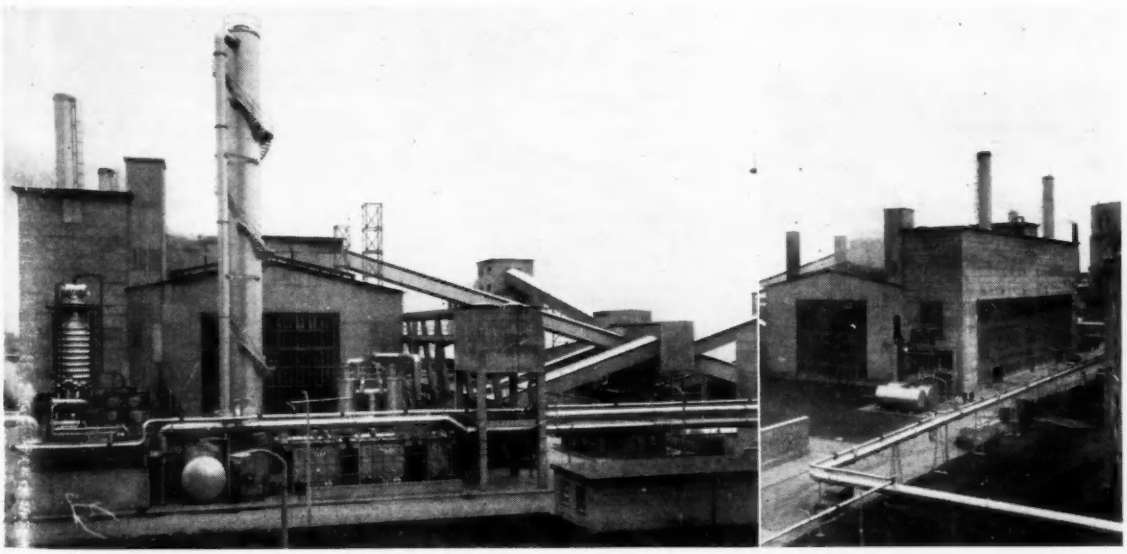
CONVEYORS

The coal is delivered in 20-ton bottom-discharge wagons into an underground hopper, from which it is fed by two vibrating feeders to a horizontal cross belt conveyor. This is followed by an inclined belt conveyor provided with a magnetic head pulley to remove tramp metal from the coal. A second inclined belt conveyor takes coal from No. 1 junction tower to No. 2 junction tower and the coal is then fed either to a third inclined conveyor (which also takes coal from the mixing bunkers) delivering to the chamber house coal storage bunker, or alternatively to a fourth inclined conveyor delivering to the reinforced concrete mixing bunkers.

At the mixing bunkers the coal is delivered to a radial conveyor which can feed coal into any of the four separate compartments of the mixing bunker, total capacity of which is 1,000 tons. From the mixing bunkers, coal is fed by four variable capacity belt feeders, to the third inclined conveyor which delivers to the chamber house coal storage bunker. At the chamber house storage bunker the coal is fed to a reversible type shuttle conveyor which can discharge to any of the four storage bunkers.

The coal handling plant has a capacity of 120 tons per hour, and sequence control is provided throughout. All gantries are sheeted both on roof and sides with corrugated aluminium sheeting, a

The benzole and the wet purification plant at the rear of the chamber house. Right: The chamber house and the bunker building.



continuous gap being left between the side sheets and roof for lighting and ventilation.

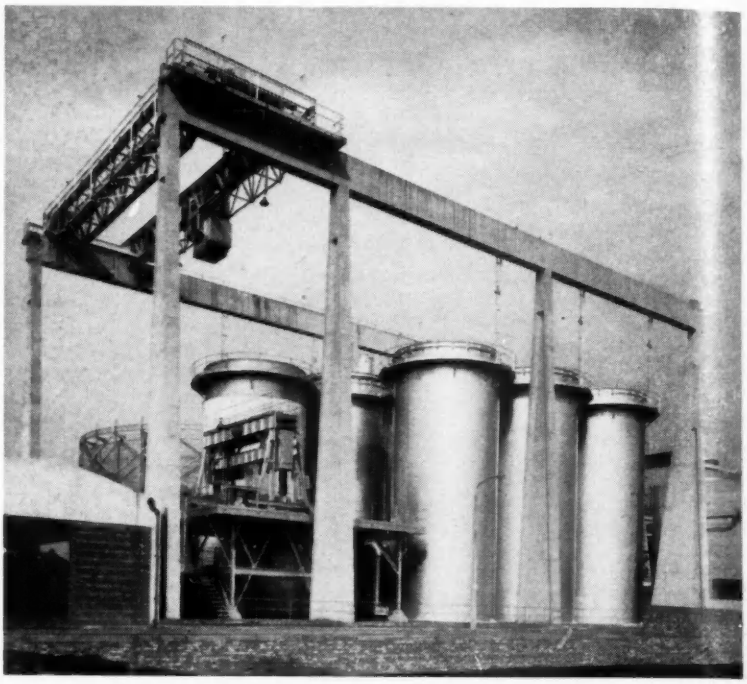
The coal and pad coke are fed into the vertical carbonising chambers by means of charging cars. There is a separate car for each bench, and each car consists of a structural-steel frame provided with two sets of three hoppers for receiving coal and pad coke respectively. From the three outlets, both the pad coke and coal can be discharged without having to move the car. Hand-operated drop sleeves which register with the charging holes on the chambers prevent the gas normally generated during the charging operation from escaping into the chamber house. The capacity of the coal and pad coke hoppers is sufficient for one charge but each coal hopper is provided with an adjustable plate so that the operator can pre-determine the exact amount of coal to be fed into the chambers.

HOT COKE CARS

The coke is discharged from the base of the chambers into electrically-propelled hot coke cars—a separate car for each bench—operating on rails laid beneath the bench. Each car has a removable container, split centrally and hinged together at the top. With its load of hot coke the car travels to a quenching station—of which there are four situated inside the house—where the coke is quenched by a pre-determined volume of water. At each quenching station a closable door and a chimney prevents the emission of steam into the carbonising house, while baffles and sprays fitted in each chimney, minimise the discharge to atmosphere of steam and grit. The surplus water from the quenching operation runs to settling pits, from which the clarified water is re-circulated, and settled coke breeze extracted by grab.

Passing from the quenchers the container is lifted from the car by one of two telpher crabs, travelling on a track carried on a reinforced concrete structure, which spans the inclined coke wharves. All the telpher operations are remotely controlled by push-button from control panels arranged at each lifting point and provided with indicating lights.

At the coke wharves provision is made for spot quenching of the coke, and the coke is discharged through finger gates. The wharf conveyors, of which there are two, normally deliver to either of the two central collecting conveyors, but the north unit is reversible and can be used to take coke from the wharves to stock. For reclaiming from stock, coke is discharged to an independent hopper, from which it is taken by belt conveyor to one of the central collecting conveyors. The two collecting conveyors deliver in turn at a transfer tower to two further inclined conveyors which feed the coke screening plant.



A general view of the tower purifier plant, showing the reinforced concrete gantry and, on the left, the oxide treatment plant and the oxide shed.

SCREENS

The coke screening plant consists of two identical lines of screens, mounted above the reinforced concrete coke storage hoppers. Each set of screens which has a capacity of 40 tons per hour, consists of a scalping screen of the vibrating double-deck type and a sizing screen of the reciprocating type, with an interposed common coke cutter to deal with oversizes as and when required. Sequence control is provided for conveyors and screening plant.

The coke storage bunker has a capacity of 800 tons of coke and is divided into five compartments of sizes to suit the various grades of coke. The sloping cones of the storage hoppers are tile-lined, and two cast-iron spiral shoots are provided in the large-coke compartment to minimise coke breakage.

Vibrating feeders take any of three sizes of coke and deliver producer coke or pad coke to a collecting belt conveyor. Fixed debreezing screens of the vibrating

LIST OF CONTRACTORS AND SUPPLIERS

WEST'S GAS IMPROVEMENT CO. LTD. (C.O.L. DIVISION)	Carbonising, coal and coke handling plants
NEWTON CHAMBERS & CO. LTD	Tower purifiers
DEMOLITION & CONSTRUCTION CO. LTD.	Foundations and structures
HOLST & CO. LTD.	Foundations and structures
W. C. HOLMES & CO. LTD.	Benzole plant
	Connersville meter
	Gas mains
	Gas valves
SIMON CARVES LTD.	Wet purification plant
	Concentrated ammoniacal liquor plant
P. G. ENGINEERING LTD.	Producers
THOS. W. WARD LTD.	Railway sidings
PETER BROTHERHOOD LTD.	Turbo-alternator
NORTH EASTERN ELECTRICITY BOARD	H. V. cabling switchgear and transformer
DAVENPORT ENGINEERING CO. LTD.	Water cooling towers
JOHN THOMPSON-KENNICOTT LTD.	Water softening plant
GEO. WALLER & SONS LTD.	Exhausters
LANCASHIRE DYNAMO & CRYPTO LTD.	Main switchboard and alternator
	Electric motors
ALLEN WEST & CO. LTD.	Electric motor starters
D. & J. RANKEN LTD.	Miscellaneous building works
WM. NORMAN	Miscellaneous building works
J. & T. PARKER LTD.	Miscellaneous building works
ROBERT FRAZER & SONS LTD.	Miscellaneous steelwork
W. H. SMITH & CO. ELECTRICAL ENGINEERS LTD.	Electrical installation
ROBSON & COLEMAN LTD.	Electrical installation
BONHAM ELECTRICAL & ENGINEERING CO. LTD.	Electrical installation
STEELS ENGINEERING INSTALLATIONS LTD.	Steam, water and other service mains
JAMES HOGG & SONS (NORTH SHIELDS) LTD.	Steam, water and other service mains
COLVIN SMITH LTD.	Steam, water and other service mains
J. W. ELLIS & CO. LTD.	Gas mains
STEELS ENGINEERING PRODUCTS LTD	Mobile crane
SAML. DENISON & SON LTD.	30-ton motor wagon weighbridge
PYE LTD.	Television equipment
MURRAY SWANSON & CO. LTD.	Loudspeaker system
IMPERIAL CHEMICAL INDUSTRIES LTD	Paint
A. CAMERON & SONS LTD.	Paint
WM. LATIMER & CO. LTD.	Painting contractor
A. HECTOR GRABHAM	Painting contractor

type are provided for feeding rail and road transport, and provision is made on certain sizes for direct delivery from the storage bunkers to road transport. The breeze from the debreezing screens is discharged to small storage hoppers and thence to rail wagons as and when required. Four pre-set automatic weighers, complete with special hoppers have been provided to weigh coke into 1-cwt. bags.

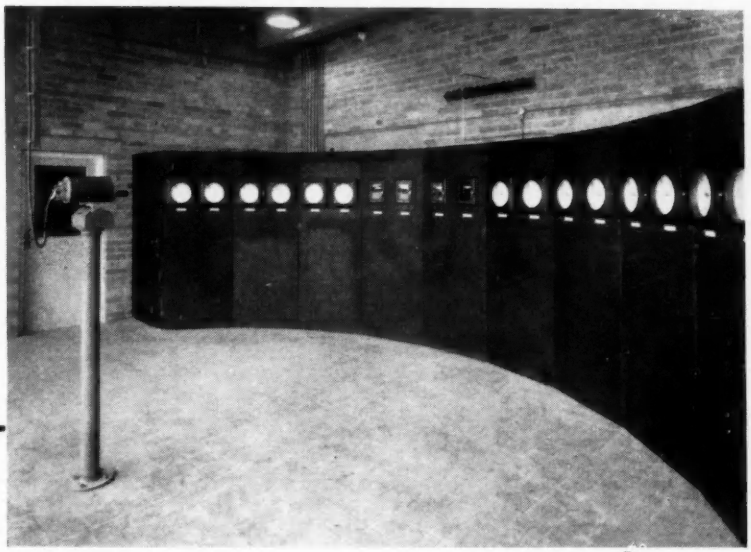
Coke for the producers and for the chamber pads is collected on the belt conveyor running underneath the coke storage bunkers provided with a belt weigher for recording the weight of coke supplied to the plant. From this belt the coke is transferred at No. 2 junction tower to a second conveyor which runs over the top of the producer coke bunkers, and distributes producer coke as required by means of a travelling tipper. Chamber pad coke is discharged over the end of this conveyor to a short inclined conveyor feeding a reversible shuttle conveyor, which delivers pad coke to any of the four pad coke bunkers.

The producer-gas plant installed in the chamber house and comprising four mechanical producers—one stand-by—supplies the diluent gas as well as the heating gas for the carbonising plant. Of the self-vaporizing type, each is capable of gasifying 32 tons of coke per 24 hours at normal load, and each is equipped with a revolving grate, automatic continuous ash discharge, an internal distributing chute to ensure an even bed, air-blown poke-holes and mechanically-operated coke feed.

Each revolving grate is electrically driven through a reduction gear designed to give a wide range of speeds. Air for operating the producers is supplied by two electrically-driven blowers, housed at ground level beneath the coal and coke pad bunkers, each of which is capable of dealing with the maximum requirements of any three producers. Four dust-catchers of the Vortex pattern lined internally with firebricks are provided, one for each producer. The producer gas is led to the carbonising benches through welded-steel mains lined with refractory and insulating brickwork. Pressure in these mains is automatically maintained at the desired pre-determined value by Askania control of the primary air.

Ash, continuously discharged from each producer, drops into a small receiving hopper, from which it is discharged to a belt conveyor running under the house floor. The ash is discharged into a reinforced concrete storage hopper built integrally with the main junction tower,

TV IS THERE



An attendant (left) reads meters by TV in the central control room of the Sunderland gasworks while the remote control camera keeps an 'eye' on the dials in the instrument room (above).

Using a closed circuit television system installed by the Industrial Division of Pye TVT Ltd., the attendant can bring to his screen pictures from any one of five cameras strategically positioned throughout the gasworks.

This permits readings from all important operational instruments to be taken in a matter of minutes, making it unnecessary for the attendant to patrol the works at regular intervals.

This installation constitutes a beginning in the field of full instrument surveillance by remote-controlled closed-circuit television.

The Northern Gas Board already envisages installing a second monitor screen in the site engineer's office, so that the site engineer can follow the readings, while at the same time being immediately available should a fault be detected.

from which it is discharged directly to either road or rail vehicles.

Steaming of the carbonised charge is maintained at the minimum value consistent with overall economic operation and producer gas is used to reduce the calorific value of the gas to the desired figure. Diluent gas is drawn from a branch on the producer-gas manifold, and passing through a Lymn washer enters the coal gas main on the suction side of the exhausters. The volume of producer gas taken into the gas stream is regulated by a valve electrically operated from the control room by an attendant. A Fairweather calorimeter indicator installed in the control room indicates the calorific value of the mixed gases.

W.H. BOILERS

Four Spencer-Bonecourt horizontal waste-heat boilers are installed in the carbonising house, one pair at the extreme north and the other pair at the extreme south end of the bunker structure, serving the north and south units respectively. Designed for a working steam pressure of 250 p.s.i. with a superheat of 200°F., each is capable of handling the waste gas from one bench of chambers. Four electrically-driven induced-draught fans, and two electrically-operated feed-water pumps and associated tanks are provided for the boiler installation; each pump is capable of meeting the requirements of the four boilers under full load. A standby steam-driven pump capable of handling the full normal load of the boiler plant has also been installed. Full instrumentation is provided. There are two brick-lined steel chimneys, each of which is large enough to provide adequate natural draught for two benches, that is, 36 chambers.

A remotely controlled television camera in each boiler room can scan the relevant gauges and instruments for the attendant in the control room to record the necessary instrument readings at set intervals.

RING MAIN

A high-pressure steam ring main supplies the turbo-alternator, and a separate, saturated steam main supplies the back pressure engines driving the exhausters—the exhaust steam from this system, which is contaminated with oil, is used for steaming the retorts. Pass-out steam from the turbo-alternator is fed into the low-pressure steam main for the ancillary plant. In the event of a deficiency of low-pressure steam, the pressure is maintained through a 'make-up' valve from the high pressure main, while a surplus is catered for by a blow-off valve. Recording steam meters are provided for measuring the steam supplied to each bench.

There are three welded mild steel vertical water-tube condensers of the modern cross-flow design, in which the gas flows horizontally at right angles to the vertical water tubes. Each is capable of efficiently cooling 4 mill. cu.ft. per day and each has incorporated a boiler feed water heater designed to preheat 1,000 gal. per hour of softened town water.

Remote indicating temperature points on water and gas mains have been fitted, together with a thermostatic water control valve operated by the temperature of the gas leaving the condensers.

Two 24-in. diameter gas mains, each from a pair of benches, bring the gas to three double impeller positive Rootes type steam-driven exhausters, one standby, handling 200,000 cu.ft. of gas per hour each, against a total pressure differential of 55 in. w.g. Suction is controlled by a standard bell type hydraulic governor operating on an equilibrium steam throttle valve.

Two exhausters working in parallel pump the gas through a single 30-in. diameter welded stress relieved gas main to two electrostatic detarrers.

There are two tubular type electrostatic detarrers, each capable of treating 6 mill. cu.ft. of gas per day with an efficiency of 99.5%. The design allows for one detarrer to deal with a total gas output of up to 10 mill. cu.ft. per day with an efficiency of 97%, but this would only arise when one detarrer either broke down or was shut off for overhaul. Each detarrer, complete with an independent high tension set of shockproof design and interlocks to safeguard works personnel, works off a standard 415-V. single-phase, 50-cycle supply, which is converted to 33,000 V. d.c.

WASHERS

Two four-bay static ammonia washer units operating in series, are capable of dealing with 10 mill. cu.ft. of gas per day. Constructed of cast-iron plates and filled with wooden hurdle packing through which the gas is passed alternately concurrent and counter-current to the washing medium, this plant has been designed to reduce the ammonia content of the gas at the outlet of the washers to 5 grains per 100 cu.ft.

The gas now passes to a two-bay naphthalene washer to remove minute traces of tar fog and a large proportion of the naphthalene from the gas, to keep gas mains and purifiers free from naphthalene deposits and tar contamination.

If benzole extraction is not practised at any particular period, the oil rate in this washer is increased so as to bring the naphthalene content of the gas as low as possible.

Fresh gas oil fed to the washer at the rate of 40 gal. per mill. cu.ft. of coal gas should reduce the naphthalene content of the gas from 15 grains to 6 grains per 100 cu.ft.

The purifier installation consists of five mild steel welded purifying towers 22 ft. 3¼ in. diameter by 53 ft. high, each of which will contain 12 trays filled with 38 tons of iron oxide. It is capable of purifying 9.6 mill. cu.ft. of gas per day, containing 700 grains of H_2S per 100 cu.ft. The design of the towers gives an R value of 37.4.

Connecting gas mains are 30-in. diameter, and hydraulic valves are provided for 'rotating' each tower in a chosen sequence; each tower is also provided with its own Newton needle steam-heated gas heater.

Handling of the trays is by an electrically-powered overhead crane of 40 tons capacity, which travels on a reinforced concrete gantry. An oxide handling plant has been included in the installation and consists of a plough-type oxide discharger, a crusher, one mobile conveyor and one mobile rotary conveyor for filling the trays.

Two Keith Blackman, four-stage, centrifugal blowers provide air for revivification of the oxide, and include a flow recorder and low gas pressure cut-out. These blowers are housed in a small building which also contains instruments for the plant, and an inert gas purging machine.

An oxide shed constructed in reinforced concrete, with a 'shell' roof and post tensioned beams completes the installation.

BENZOLE

A fully automatic benzole extraction plant, designed to remove from the gas 85% of the crude benzole and 70% of the carbon disulphide present, can reduce the naphthalene content to one grain per 100 cu.ft. with an oil circulation rate of 6,850 gal. per hour. The plant consists of a tower scrubber 8 ft. diameter by 95 ft. high, filled with six sections of timber grids, and a vacuum distillation plant together with oil and benzole storage tanks and a rack cooler.

No attendant is required, so a system of alarms for loss of vacuum, failure of oil flow, or shortage of oil in the system, have been provided in the control room in the chamber house.

A Holmes-Connersville positive meter rated at 400,000 cu.ft. per hour is housed in the benzole plant pump room.

Electrical power for the new works, as well as for plant still in use on the original works is obtained from a pass-out turbo-alternator of 765-kW capacity supported by a 750-kVA transformer connected to the North Eastern Electricity Board's supply system.

STEAM USAGE

All steam raised by the four waste-heat boilers, except that required by the exhausters, passes to the turbo-alternator to generate electrical power and produce low pressure steam for process work at 20 p.s.i. All power surplus to works' requirements is automatically exported to the Electricity Board's system.

The turbo-alternator consists of a multi-stage impulse steam turbine, designed to work on steam at 250 p.s.i., and 200°F. superheat, and fitted with a condenser capable of running at a vacuum of 28½ in. mercury, and a Lancashire Dynamo and Crypto air-cooled alternator coupled to it through reducing gears. The whole machine is housed on one continuous fabricated bedplate and installed at ground level.

Most of the cabling has been carried

out in paper-insulated cables, although P.V.C. insulated and P.V.C. sheathed cables have been used for a number of circuits. All motors are of 'gasworks' type, totally-enclosed and suitable for a 415-V. 3-phase, 50-cycle supply. All motors over 14 h.p. have been designed so that the starting current is only 4½ times that on full load. An extensive system of sequence interlocking has been provided on the coal and coke conveying systems together with numerous 'lock-out' stop buttons for emergency stopping of conveyors.

All cooling and quenching water requirements are taken from a closed circuit water system, into which town water is fed, as necessary, for make-up. To overcome the hardness of the Sunderland town water supply and the possibility of excessive scale being deposited in condenser tubes, a phosphate pre-treatment of the water has been installed.

Treated town water joins re-circulated water in the condensers and flows to a hot pond where most water from the re-circulated water system collects after use. Re-circulated water from the turbo-alternator condenser is pumped direct to the cooling tower inlet manifold.

HOT POND

Water from the hot pond is pumped to a concrete shell cooling tower, capable of cooling 108,350 gal. per hour through a temperature of 21.7°F. It consists of two units one of which may be closed down for overhaul and repair while the other unit remains at work.

Ammoniacal liquor is treated in concentration plant capable of handling 900 gal. of crude liquor per hour. The final product will contain 22-25% free ammonia, and will be stored in two 8,000-gal. mild steel storage tanks, prior to collection by tankers for delivery to the Board's Redheugh works for conversion into high grade agricultural fertilisers.

Tar and liquor produced by the new works are stored in the existing tar and liquor wells of which there are four, with a total capacity of 180,000 gal. of liquor and 290,000 gal. of tar.

SIDINGS

An extensive system of railway sidings has been provided which have a general fall from the entrance to the works, across the coal-receiving hoppers and beyond horizontally to the buffers. All track—constructed of 95-lb. bull head rail—the curves and turnouts, have been designed to suit British Transport Commission's requirements.

There is standage for 63 full coal wagons, 41 empty coal wagons, 63 full coke wagons, and further standage for 22 wagons for either coal or coke wagons as available. An elevated reinforced concrete coal gantry enables bottom discharge coal wagons to unload coal direct to a concrete paved coal stocking ground. A 40-ton weighbridge with a 16-ft. platform has been installed to weigh coke delivered from the works by rail.

The closed-circuit television system, installed to enable the assistant in charge of the control plant to view plant and take readings of unattended plant and equipment, has a 8½-in. monitor, based on a 625 line system. Equipped with pan and tilt, there are lens change and focusing remote controls, and a 5-way camera switching unit installed in the control room. Cameras have been provided in the benzole plant to read the station meter, in each boiler room to observe water level and steam pressure gauges, thermometers, and to view the room generally, in the carbonising instrument room to read all the instruments provided in a curved instrument panel, and in the purifier blower room to read instruments and to view the room generally.

A loudspeaker system, which includes eight microphones and eight loudspeakers provides communication between personel working on the coal charging car at bench top level, and those operating the bottom doors and coke car at ground level. Two microphones and two loudspeakers are installed on each bench.

THE OPENING

Plant is salutary reminder says the Minister of Power

A SALUTARY reminder that carbonising plant can still produce refined fuel at a competitive price, was the comment of the Minister of Power, the Rt. Hon. Richard Wood, when he inaugurated the reconstructed works of the Northern Gas Board at Sunderland on October 28.

The Minister said he believed that the completion of this plant had special significance at this time. It marked the culmination of a large programme of modernisation in this area which began shortly after vesting day.

The Board had illustrated at Sunderland an attitude which he was glad to see throughout the industry: A determination to perfect existing methods of gasification; development of new ideas both in manufacture and in other directions; the Board's willingness to use new developments (it was the only area where gas was stored underground); and a willingness to use other methods if more economic for particular requirements (e.g. the butane/air plant).

CLEAN

The Sunderland plant made nonsense of the widespread belief that carbonisation cannot be clean and attractive, said Mr. Wood. Side by side with this most modern example of conventional gasmaking plant would operate in a few months the first Lurgi ' complete gasification plant in Scotland. Thus coal, whether in the best of the old methods, or in entirely new methods, would continue to be a major source of gas supplies.

'Now is the time to look forward, not backward. There are new markets to be won, new developments in the industry with which to win them. Intense effort is needed to encourage sales, to increase efficiency and to make gas as attractive as possible. I have met very few pessimists in the gas industry. Most people I have met clearly realise that gas has a fight ahead. You are well equipped to fight. Your equipment is good, your morale is high and your leadership is confident. No troops can ask for more.'

Introducing the Minister, who proposed the toast of 'The Gas Industry', the Board Chairman, Mr. E. Crowther, explained that the new works completed the original programme of major engineering work embarked on by the Board. This plant was the last of nine main stations which fed the Board's two grids.

Commenting on the manner in which their fortunes were bound up with coal, Mr. Crowther pointed out that Northern Gas Board prices were the lowest in the country, 'which suggests that our policy is not gravely mistaken.'

Responding to the toast, Sir Henry Jones, Chairman of the Gas Council, referred to the Minister's encouraging remarks and suggested that his optimism was borne out by the fact that since April 1 the gas industry had put out 4% more gas, which was more than could be accounted for by the weather, and had also produced more coke, while using about the same amount of coal.

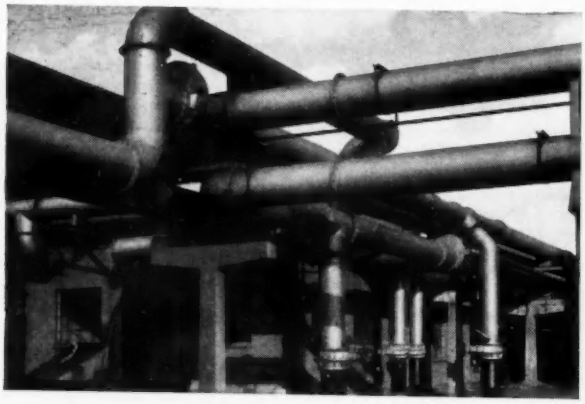
Referring to the clean air policy, Sir Henry predicted that there would be far more blue skies over Sunderland than in the past.

CONSISTENT

Proposing the toast of 'The Contractors', Mr. J. E. White, Deputy Chairman of the Board, paid tribute to all who had helped to ensure that the works was ready on time. Referring to the effect of the works on local employment, he revealed that behind the 260 people employed at the works were 170 miners; even though these numbers were small, the demand for coal was consistent.

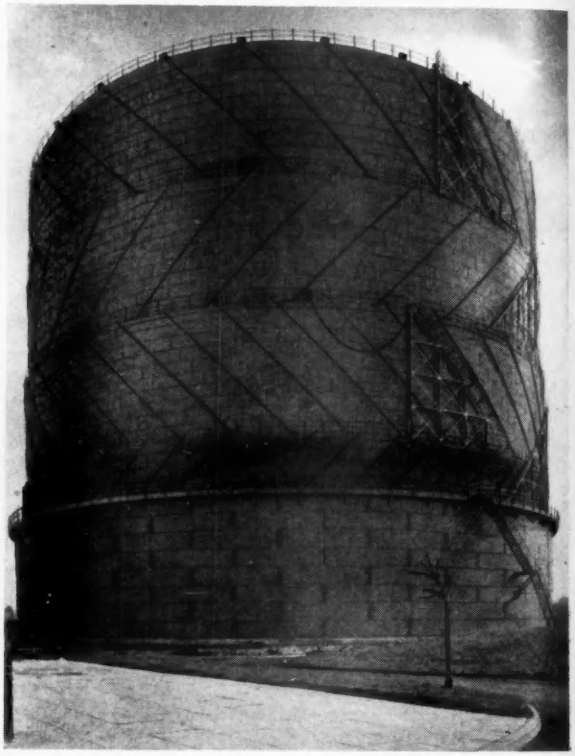
Mr. Alex E. Morris, Director, West's Gas Improvement Co. Ltd., replied.

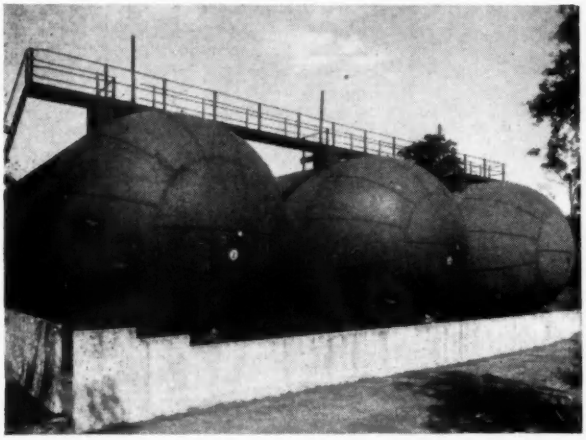
The Minister was presented with a souvenir pen stand bearing the same words as appeared on the plaque which he had unveiled earlier.

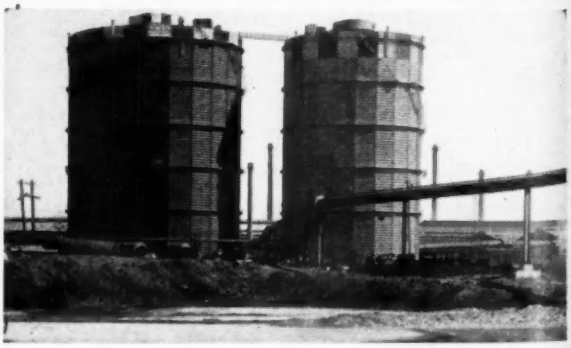


CLAYTON

THE GASHOLDER SPECIALISTS







Top left
36" and 30" overhead gas mains

Top right
Concrete lined and sheathed Tubes

Centre left
High Pressure Gas Holders

Centre right
6 million cubic feet capacity Spiral Guided Gas Holder

Bottom right
5 million and 3 million cubic feet capacity Waterless Gas Holders

CLAYTON SON & CO. LTD
MOOR END WORKS, HUNSLET, LEEDS 10